Name: Period:

**STEAM Critical Zone Investigation Unit**

**Final Project Rubric – Essay Format – 100 total points**

1. Explain what the critical zone is and how it effects watersheds. (10 points)
2. Identify the intricacies of a watershed and describe how runoff positively and negatively effects it. (25 points)
   1. Intricacies – What is a watershed? How are watersheds like networks?
3. Differentiate between point source and non-point source pollution. Provide three examples of each. (10 points)
4. Analyze the data collected with respect to our watershed. What do the physical, chemical, and biological test results mean? (55 points)

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**STEAM Critical Zone Investigation Unit**

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1. Explain what the critical zone is and how it effects watersheds. (10 points)

The critical zone is the Earth’s outer skin where rock meets life. This environment is where rock, soil, water, air, and organisms interact thus shaping the Earth’s surface; all layers are permeable, allowing water to pass through. This zone regulates habitat and the amount of resources. The critical zone is shaped by long and short term responses, taking place by seconds or over many eons. The critical zone processes shape and sustain all life on Earth. This zone is impacted heavily on and by humans, which is not well characterized or understood.

1. Identify the intricacies of a watershed and describe how runoff positively and negatively effects it. (25 points)
   1. Intricacies – What is a watershed? How are watersheds like networks?

Watersheds are areas of land that drain into some body of water; their boundaries are determined by the guiding contours of the land that surround that specific water system. Drainage patterns consist of smaller channels merging into larger ones, thus working like a branching network. Tributaries flow into streams, which eventually flow into rivers and further into the ocean. Similarly, in trees, small twigs/branches flow into the main tree branches which then head into the trunk.

Runoff is the dominant way in which water flows from one location to another, falling upon the surface and running into streams, lakes, rivers, oceans, or any other water system. Runoff is the main way in which pollutants enter the waterways. Runoff positively keeps the water cycle flowing, and opposite that, runoff is what allows contaminants to flow from small streams into much larger water systems.

1. Differentiate between point source and non-point source pollution. Provide three examples of each. (10 points)

Point source pollution – the object of contamination can be traced from a specific location

Non-point source pollution – the object of contamination is difficult to locate where it entered

Examples of non-point source pollution are:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Urban | Non-point | Sediments from bare soils; bacteria from wastes; nutrients from fertilizers | Oil from parking lots; gasoline; metals | Antifreeze and grease; pesticides; trash |
| Residential | Non-point | Lawn fertilizers; sediments; bacteria from pet wastes; oil drained from cars | Septic tank overflows; gasoline; detergents used to wash cars | Antifreeze and grease; pesticides; trash |
| Construction | Non-point | Sediments (soil, clay, silt) | Nutrients from fertilizers | XXXXXXXXXXXX |
| Agriculture | Non-point | Fertilizers (crops), sediments | Bacteria, ammonia | Pesticides, herbicides, insecticides |

Examples of point source pollution:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Industrial | Point | Chemicals | Products | Oil/gas facilities |
| Wastewater Treatment Plant | Point | Nutrients | Bacteria | Sediments |

1. Analyze the data collected with respect to our watershed. What do the physical, chemical, and biological test results mean? (55 points)

Answers will vary depending on what data is collected at the sites, but it all stems from the information below.

Physical:

* Stream cover – What percentage of stream is covered by plants? What types of plants are surrounding the stream? How might the types of plants effect the stream?
* Depth of stream – How deep is the stream? Take 3 measurements (from the bottom surface to the tip of water) at different locations and average them.
* Flow rate – How fast is the stream flowing? Find a start and finish location ranging 7 feet apart. Person A holds one end of string and Person B holds the opposite end of string. Person A drops floating object along string when Person B says start, using the timer. Person B stops the timer when the floating object arrives. To be completed 3 times and averaged
* Width of stream – How wide is the stream? Take 3 measurements (from one side to the other) at 3 different locations and average them.
* Odor – What does it smell like? Any unique smells?
* Color – What color is the water? What color is the mud on the bottom?
* Temperature of water and air – Use thermometer to take both the temperature of the air and water

Chemical:

* Total alkalinity – measures the ability to keep the pH from changing
  + Important because it keeps the water protected from shifts in pH; less vulnerable to acid rain
    - 50 ppm is low
    - 200 ppm is high
* Acidity/pH – measures the hydrogen ion concentration
  + pH <7 is acidic
  + pH>7 is basic
  + Normal range is 6.7-8.6
* Total hardness – measures the calcium and magnesium
  + Soft = 0-60 ppm
  + Hard = 121-180 ppm
  + Very Hard = >180 ppm
* Dissolved oxygen – measures the amount of oxygen dissolved in water
  + Most important gas for aquatic organisms
    - The colder the water, the more DO
    - The faster the flow, the more DO
      * 5-6 ppm sufficient
      * <3 stressful to most
      * <2 fatal to most
* Nitrates – measures the fertilizer/organic matter in water
  + Important because plants need nitrogen in that form for survival
    - 1 mg/L = 1 ppm
* Turbidity – measures the cloudy appearance of water
  + Major indicator on how well light passes through the water; light is needed for plants to photosynthesize, as well as helping with the production of oxygen
    - <5 JTU’s

Biological:

* Macroinvertebrates – organisms without backbones large enough to be seen with the naked eye and live on the bottom of a stream
* Collected in riffles, places where water flows quickly
* 3 groups
  + 1 = Sensitive to water pollution
    - caddisfly, hellgrammite (dobsonfly), mayfly, stonefly larva, riffle beetle, and water penny
  + 2 = Somewhat sensitive to water pollution
    - alderfly, riffle beetle larva, cranefly, damselfly, dragonfly larva, fishfly, sowbug larva, whirligig beetle larva, scud larva, and watersnipe fly
  + 3 = Tolerant to water pollution
    - Aquatic worm, blackfly larva, midgefly, leech